PILOT STUDY OF A SHEET PATTERN FOR A GAPLESS GENERIC FACEMASK AROUND A FEMALE OPENED MOUTH

Mika Morishima[1], **Tamaki Mitsuno**[2]
[1] *Kanazawa university, Faculty of Education, Institute of Human and Social Sciences*
[2] *Shinshu university, Faculty of Education, School of Humanities and Social Sciences*
morishimam@staff.kanazawa-u.ac.jp

EXTENDED ABSTRACT

Key Words: FACE MASK, FIT, AIR GAP

1. INTRODUCTION

Generic facemasks protect the wearer and surrounding people from harmful substances during everyday activities. However, when the wearer opens the mouth, an air gap may appear between the sheet edge of the facemask and the wearer's face. When the air gap exposes the wearer's nose and mouth, the wearing effect is reduced.

Previously, an available facemask was tested on a female Japanese head mannequin with closed mouth. The macro air gap at the edge of the upper sheet appeared around the wearer's nose, exposing the nose and mouth area. Based on the results, facemask sheet patterns with high fit performance was designed on a younger female participant with a closed mouth. This study analyses the proposed pattern in the open-mouth scenario.

2. METHODS

2.1. Subjects

The pilot test was performed on five young women (average age = 22.6, standard deviation: S.D. = 2.5). The characteristics of their heads were measured using a measuring tape and spreading caliper according to the Japanese Industrial Standard (JIS Z 8500:2002). The means (S.D.) of the circumference, length, breadth, and bigonial breadth of the heads were 557.6 mm (S.D. = 20.4), 181.8 mm (S.D. = 8.1), 150.0 mm (S.D. = 3.7) and 103.6 mm (S.D. = 3.20. The measured data were within the range of average ± S.D. for Japanese female adults (Anthropometric Database of Japanese Head 2001, H16PRO-212 as collected by the National Institute of Advanced Industrial Science and Technology) [1].

2.2. Measurement of facial shape

For the fabrication of a mask sheet that fits the facial surface, the three dimensional (3D) coordinates of a subject's face were measured using a 3D motion analyser (Dipp-Motion Pro; Ditect Co.). The sheet was manufactured in four sizes, and accommodated 94 points set on the face as follows: 18 landmark points were set around her nose and mouth (forming the first ring). Based on these points and considering the air gap around the nose area, additional 24 points (second ring), 26 points (third ring) and 26 points (fourth ring) were arranged radially at 10-mm intervals. To enhance the fit around the wearer's nose, the points were placed on the boundary between the nose and cheek. The participant pronounced 'ma-mi-mu-me-mo' with a maximally opened mouth. The facial shapes were measured using three infrared cameras. The

study protocol for the subjects was approved by the Institute of Human and Social Sciences Ethics Committee, Kanazawa University (permitted IRB no. 2017–33).

2.3. Data analysis

Considering the tip of the nose to be the origin point the 4 sheet sizes were analysed for each subject. Based on the measured 3D data, the distances and inner angles between the points were calculated [2]. And then, the 3D coordinates were transformed into two-dimensional(2D) patterns via triangle combinations [3].

3. RESULTS AND DISCUSSION

For all mouth shapes, the smallest pattern was ellipse-shaped. All other patterns under all conditions revealed points on the nose ridge in the first and second quadrants. After combining the points, the two-dimensional pattern was shaped like a circular cone.

Subsequently, the patterns formed by the maximally opened mouth were compared with the closed-mouth patterns. The upper points corresponding to the nose area were similar in all patterns; however, the distances between the other points varied concentrically in the vertical direction. In the lower area, points corresponding to the lower lip (first ring) and lower jaw (rings 2–4) varied by 45.1(S.D=3.6), 44.7(S.D=4.3), 43.3(S.D=4.8) and 42.0(S.D=5.3) mm between the closed- and open-mouthed cases, respectively. Such deformations must be considered in the facemask design to ensure a sheet without air gaps, particularly in the nose area.

From these results, the method of testing and analysis herein were appropriate for the proposal of a pattern without air gaps in an open-mouth scenario. In the near future, the patterns of different mouth shapes of more participants will be analysed and a prototype sheet without an air gap will be proposed.

4. CONCLUSION

A mask sheet pattern without air gaps in the open-mouth scenario was proposed through measurement of a female facial shape using a 3D analyser. The 3D coordinates were identified, and the sheet patterns were analysed through triangle combinations. The patterns obtained under the open-mouth and closed-mouth scenarios were compared; deformations in the lower area of the sheet were observed to be larger than those in the upper area. These deformations are necessary considerations for the proposal of the sheet pattern with no air gaps.

ACKNOWLEDGEMENT

This work was supported by JSPS KAKENHI (Grant Number 17K00782).

REFERENCES

1. M. Kouchi and M. Mochimaru, "Anthropometric database of japanese head 2001," National Institute of Advanced Industrial Science and Technology, 2008, H16PRO-212.
2. M. Morishima, T. Fujiyama, Y. Shimizu, and T. Mitsuno, "Analysis of fit pattern of a hygiene mask for an opened mouth," Textile Research Journal, 2016, vol. 86, 933-947.
3. T. Masuda and H. Imaoka, "Estimation of body form factor for developing of trunk surface (Part 1) : Structure conditions for making front bodies pattern (in Japanese)," Journal of home economics of Japan, 1004, vol. 45, 1017-1027.